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| 09/822,535      | 03/30/2001  | Erik S. Ruf          | MS                     | 1094             |
|                 | 7590        |                      | 160347.2/40062.120US01 |                  |
|                 | 07/26/2005  |                      | EXAMINER               |                  |
|                 |             |                      | RUTTEN, JAMES D        |                  |
|                 |             |                      | ART UNIT               | PAPER NUMBER     |
|                 |             |                      | 2192                   |                  |

DATE MAILED: 07/26/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

## Office Action Summary

Application No.

09/822,535

Applicant(s)

RUF, ERIK S.

Examiner

J. Derek Rutten

Art Unit

2192

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

### Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

### Status

- 1) ☒ Responsive to communication(s) filed on 20 April 2005.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

### Disposition of Claims

- 4) ☒ Claim(s) 1-23 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-23 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

### Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 30 March 2001 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

### Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
  - ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

### Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)  
Paper No(s)/Mail Date \_\_\_\_\_
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: \_\_\_\_\_

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### DETAILED ACTION

1. Acknowledgement is made of Applicant's amendment dated 20 April 2005, responding to the 10 February 2005 Office action provided in the rejection of claims 1-23, wherein claims 1, 12, 22, and 23 have been amended, no claims have been canceled, and no new claims have been added. Claims 1-23 remain pending in the application and have been fully considered by the examiner.

2. Applicant's arguments, see pages 11-12, filed 20 April 2005, with respect to the rejection(s) of claim(s) 1-23 under U.S.C. § 103 have been fully considered and are persuasive. Therefore, the rejection has been withdrawn. However, upon further consideration, a new ground(s) of rejection is made in view of "Improving the Performance of AI Software Payoffs and Pitfalls in Using Automatic Memoization" by Hall et al.

3. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the date of this final action.

*Response to Arguments*

4. On page 9 of the reply, Applicant argues that the objection to the drawings should be withdrawn in light of amendments to both the drawings and the specification. However, an amendment to the drawings was not found with the reply. Therefore, the objection to FIG. 1 is maintained. Further, Applicant's amendments to the specification are not sufficient to overcome the previous objection of FIG. 8. While the specification amendment appears to attempt to incorporate the compiler and optimizers of the invention into elements 35-38 of the drawing, these compilers and optimizers are not actually illustrated in the drawing. Elements 35-38 illustrate well known technology and are not illustrated with features of Applicant's invention. Page 5 lines 9 and 10 of the originally filed specification recites:

FIG. 8 illustrates an exemplary system useful for implementing an embodiment of the present invention.

This establishes the figure as an illustration of a tool used for *implementing* the invention and not as an illustration of the invention itself. In the absence of an illustration of features of Applicant's invention, the figure continues to illustrate the prior art. Furthermore, Fig. 1 of U.S. Patent 6,044,155 to Thomlinson discloses an essentially identical figure more than one year prior to applicant's application. In the absence of any new element illustrations in the figure, only that which is old is illustrated. Thus, the objection to the drawing is maintained.

5. Applicant argues on pages 11 and 12 that Bacon teaches away from generating tables and instructions before the invocation of a target method. Applicant provides a quote from Bacon as proof that he does not generate an optimized instruction prior to invoking the target method:

In such cases it is possible *to cache the results of recent invocations*. *When the procedure is called again* with the same arguments, the cached result is used instead of re-computing it...  
(Prior emphasis retained)

While it is agreed that Bacon's implementation populates the constant table at runtime, this quote is somewhat misleading in regard to the generation of an optimized instruction. In fact, Bacon discloses *generating* optimized instructions at compile time, and using those optimized instructions in place of the procedure call. See Figure 51 on page 392, particularly the instruction "y = f\_CACHE[i]". This optimized instruction is generated at compile-time, before invoking at run-time, the target procedure. As such, Bacon cannot teach away from generating an optimized instruction before invoking the target procedure.

In regard to the argument that Bacon teaches away from generating a table before invoking the target method, it is noted that Bacon discloses the concept of memoization, which replaces a function call with access to a table. Further, Bacon does not in any way discourage the generation of a table prior to program execution. In fact, a basic premise of Bacon is that a statically optimized program is advantageous. While Bacon does not expressly disclose the population of the constant table prior to invoking the target method, he does not discourage it. Therefore, this argument is not convincing.

6. Applicant's arguments on page 12 regarding the Johnson reference are moot in view of the new ground of rejection.

7. Applicant's arguments on pages 12-13 regarding the McNamee reference are not persuasive for similar reasons as set forth above in regard to the Bacon reference. McNamee does not discourage the generation of tables prior to invocation of a target method.

***Drawings***

8. Figures 1 and 8 should be designated by a legend such as --Prior Art-- because only that which is old is illustrated. See MPEP § 608.02(g). Corrected drawings in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. The replacement sheet(s) should be labeled "Replacement Sheet" in the page header (as per 37 CFR 1.84(c)) so as not to obstruct any portion of the drawing figures. If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

9. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they do not include the following reference sign(s) mentioned in the description: 20 ("computer 20" – page 22 line 14 of the originally filed specification). Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

***Claim Rejections - 35 USC § 112***

10. The following is a quotation of the second paragraph of 35 U.S.C. 112:

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The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

11. Claims 22 and 23 are rejected under 35 U.S.C. 112, second paragraph, as being incomplete for omitting essential structural cooperative relationships of elements, such omission amounting to a gap between the necessary structural connections. See MPEP § 2172.01. The omitted structural cooperative relationships are: The relationship of the computer program product with the constant return optimizer, or some other functional element appearing in the body of the claim to provide a concrete structural relationship with the computer program product.

*Claim Rejections - 35 USC § 103*

12. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

13. Claims 1-23 are rejected under 35 U.S.C. 103(a) as being unpatentable over prior art of record "Compiler Transformations for High-Performance Computing" by Bacon et al. (hereinafter referred to as "Bacon") in view of "Improving the Performance of AI Software Payoffs and Pitfalls in Using Automatic Memoization" by Hall et al. (hereinafter referred to as "Hall") in view of prior art of record "Developing a Tool for Memoizing Functions in C++" by McNamee et al. (hereinafter "McNamee").

In regard to claim 1, Bacon discloses:

*generating a return constant table having an entry associated with a constant return value of the target method of the receiver object; See pages 391-392, Section 6.8.9:*

Memoization is an **optimization** that is applied to **side-effect free procedures** (that is, procedures that do not change the state of the program, also called referentially transparent). In such cases it is possible to cache the results of recent invocations. When the procedure is called again with the same arguments, the cached result is used instead of recomputing it [Abelson and Sussmun 1985; Michie 1968].

Further, see the example in Figure 51 on page 392 where the table, or “cache” real

`f_CACHE[n]` is created to store the constant return value of the target method.

*generating, before invoking a target method, an optimized instruction in association with the call site to retrieve, without requiring a function call, via the return constant table the constant return value associated with the target method. As cited above, see Figure 51 on page 392. The function call to `f(i)` is replaced with a table lookup to `f_CACHE[i]`. The original function call `y = f(i)` in Figure 51(a) is replaced with the optimized instruction `y = f_CACHE[i]` appearing at the end of Figure 51(b). Note that this optimized instruction is generated during the optimization phase of compilation, before invoking the target function.*

Bacon does not expressly disclose: wherein populating the table is done *before invoking a target method*, a computer program product, or objects.

However, in an analogous environment, Hall teaches that a table can be built prior to running an application. The table is then accessed during program invocation. See page 4, section 3.3 (lines 14-18):

This is normally addressed by building a special purpose data file, and filling the values with an off-line execution of the expensive routine. Then, the function in question is modified to access that file.



It would have been obvious to one of ordinary skill in the art at the time the invention was made to use Hall's teaching of offline execution with Bacon's teaching of memoization. One of ordinary skill would have been motivated to reduce the programmatic expense of complex calculations (Hall Section 3.3).

Also, in an analogous environment, McNamee teaches a computer program product. See page 22, 1<sup>st</sup> column 2<sup>nd</sup> paragraph:

We are developing a Java memoization tool and we encourage feedback on ways to improve a C++ utility. The C++ package can be obtained electronically at:  
<http://apl.jhu.edu/~paulmac/c++-memoization.html>

McNamee further teaches the use of the object-oriented language C++ which inherently provides objects. It would have been obvious to one of ordinary skill in the art at the time the invention was made to use McNamee's teaching of program product and objects with Bacon's memoization. One of ordinary skill would have been motivated to transform exponential time algorithms to run in linear time (See page 17 paragraph 1).

In regard to claim 2, the above rejection of claim 1 is incorporated. Bacon further discloses the insertion of a constant return value in a cache (pages 391-392, Section 6.8.9).

In regard to claim 3, the above rejection of claim 1 is incorporated. Bacon further discloses the insertion of a constant return value in a separate cache (pages 391-392, Section 6.8.9 as referenced above). Bacon does not expressly disclose a dispatch table. However, McNamee teaches memoization in the C++ programming language which

inherently provides a dispatch table. Upon transformation of a function to a memorized function, a return constant table is generated that is no longer associated with the dispatch table. See Figure 1 lines 10-19.

In regard to claim 4, the above rejection of claim 3 is incorporated. Bacon further discloses using a cached result with a procedure (page 391 Section 6.8.9 and page 392 Figure 51).

In regard to claim 5, the above rejection of claim 1 is incorporated. Bacon further discloses the determination of a procedure as being non-transformable (page 391, Section 6.8.9, paragraph 1: “side-effect free”), and insertion of a return value into a cache (page 391 Section 6.8.9, paragraph 1).

In regard to claim 6, the above rejection of claim 1 is incorporated. Bacon further discloses: evaluating a plurality of possible target methods for the identification of constant return values (pages 391, Section 6.8.9, 1<sup>st</sup> paragraph).

In regard to claim 7, the above rejection of claim 1 is incorporated. Bacon further discloses the application of function memoization only in the case when there are no side-effects (page 391 Section 6.8.9 paragraph 1).

In regard to claim 8, the above rejection of claim 1 is incorporated. Bacon further discloses the generation of fetching instructions for retrieval of a return value from a data structure (page 392 Figure 51).

In regard to claim 9, the above rejection of claim 1 is incorporated. Bacon further discloses evaluating a plurality of possible target methods and identification and storage of return values (pages 391-392, Section 6.8.9).

In regard to claim 10, the above rejection of claim 1 is incorporated. Bacon further discloses constant propagation including:

*identifying a restricted set of one or more values of a control variable associated with a control operation (page 380 Figure 35: "n=64");*

*identifying a restricted set of one or more types associated with the restricted set of one or more values of the control variable (Compilers inherently identify the types of variables used in the programs that they analyze. Without type identification, a compiler might attempt calculations with two incompatible pieces of data.); and*

*optimizing one or more control targets associated with the control operation based on the restricted set of one or more types (pages 379 and 380, Section 6.6.1 and Figure 35).*

In regard to claim 11, the above rejection of claim 1 is incorporated. Bacon further discloses constant propagation including:

*identifying a restricted set of one or more values associated with a control variable (page 380 Figure 35: “n=64”);*

*identifying one or more target methods providing the values associated with the restricted set (page 380 Figure 35);*

*mapping between the restricted set of values of the control variable and a restricted set of types based on the one or more target methods (Mapping values of variables and types or methods is an inherent operation of compilers. Without mapping, a compiler might attempt calculations with two incompatible pieces of data.); and*

*optimizing one or more control targets associated with the control statement based on the restricted set of types (pages 379 and 380, Section 6.6.1 and Figure 35).*

In regard to claim 12, Bacon discloses a method. See the 1<sup>st</sup> paragraph of Section 6.8.9 appearing on page 391. All further limitations have been addressed in the above rejections of claims 1 and 6.

As per claims 13-21, the above rejection of claim 12 is incorporated. Further, all other limitations have been addressed in the above rejections of claims 2-4 and 6-11, respectively.

As per claims 22 and 23, all limitations have been addressed in the above rejections of claims 1 and 10, respectively.

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***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to J. Derek Rutten whose telephone number is (571) 272-3703. The examiner can normally be reached on T-F 6:00 - 4:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tuan Q. Dam can be reached on (571) 272-3695. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

jdr

  
TUAN DAM  
SUPERVISORY PATENT EXAMINER